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Organizational readiness for digital innovation: Development and empirical calibration of a construct

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Abstract

The advent and proliferation of digital technologies purport to increase the innovation potential of most organizations. However, approximately 90% of new ideas never convert to new product or service deliveries because of the lack of organizational readiness. This paper conceptualizes a formative multidimensional construct to gauge organizational readiness for digital innovations. Such a construct would facilitate cumulative research on the role of digital innovation, while benchmarking to track organizational readiness. The proposed construct includes 21 measures, categorized under seven subconstructs: resource readiness, IT readiness, cognitive readiness, partnership readiness, innovation valance, cultural readiness, and strategic readiness.

Introduction

Historically, innovation using technologies requires a substantial assembly of resources (Swanson 1994; Swanson 2012). As such, information systems (IS) scholars have identified that readiness to innovate with technologies is directly proportional to innovation outcomes and inversely proportional to innovation risks (Snyder-Halpern 2001; Walczuch et al. 2007). An early study of Larsen and Roberts (1971) note that approximately 90% of ideas never reach customers because of the lack of readiness. Similar observations were made four decades later by a technology consulting firm, Gartner (2009), thus highlighting that organizations lose substantial opportunities because of their lack of readiness. These statistics highlight that despite the recent advancements in technologies such as cloud, wearables, internet-of-things, mobile, social media, and business analytics, where organizations are purported to have unprecedented opportunities to innovate (Nylén and Holmström 2015; Sedera et al. 2016; Yoo et al. 2012; Yoo et al. 2010), they are not immune to innovation failures. The rise and growth of organizations such as Uber, Airbnb, and Alibaba.com are strongly attributed to the advancements in modern technologies (Sedera et al. 2016; Tan et al. 2016) and the consumerization of information technology (IT) (Harris et al. 2012; Weiß and Leimeister 2012). While such examples epitome characteristics such as availability, accessibility, scalability, and ease-of-use and ease-of-deployment of modern technologies (Lokuge et al. 2016a; Palekar et al. 2015), contemporary organizations face a new set of challenges in innovation with modern IT.

In this research, the collective term "digital technologies" has been used to consolidate modern technologies such as cloud, wearables, mobile, social media, and business analytics. Similar notions are presented in recent research (e.g., Lokuge and Sedera 2016; Sedera et al. 2016; Yoo et al. 2012). The use of an overarching term allows the study to distinguish this new wave of technologies with similar fundamental characteristics (Lokuge and Sedera 2018; Nylén 2015; Tilson et al. 2010). The traditional technologies were largely hosted in-house, focused on automating internal business processes, and highly resource intensive (Nylén 2015; Sedera and Lokuge 2017; Walther et al. 2013a). Digital technologies, on the other hand, are relatively inexpensive or available on-demand, functionally oriented, and flexible and have the potential to connect with both external stakeholders and customers (Nylén and Holmström 2015; Walther et al. 2013b; Zittrain 2006). Such features of digital technologies minimize the traditional barriers for technology innovations (Yoo 2013; Yoo et al. 2012).

Herein, digital technologies provide organizations with low capital intensity, an opportunity to innovate in a similar fashion as their resourceful counterparts (Tan et al. 2016), challenging the traditional equation of innovation with IT sophistication and resource availability (Dobbs et al. 2015; Nylén and Holmström 2015). Moreover, the innovation potential of organizations is said to have been augmented by the substantial growth in consumerization of IT, through which technologies have become accessible to average citizens as a commodity (Harris et al. 2012; Weiß and Leimeister 2012). Appendix A provides 10 recent examples of how organizations employ digital technologies to attain innovation.

However, despite the proliferation, accessibility, scalability, availability, and ease-of-use and ease-of-deployment of digital technologies (Harris et al. 2012; Lokuge and Sedera 2017), organizations are still struggling to reap the full innovation potential, and the new ideas do not manifest into product or service deliveries because of the lack of organizational readiness (Snyder-Halpern 2001; Williams 2011). Therefore, it is arguable that while organizations successful in initiating digital innovation are adorned using terms such as fast, flexible, collaborative, responsive, rewarding, and agile (Dobbs et al. 2015), innovation with digital technologies presents a new set of challenges. For organizations to excel in digital innovation, it is required that they unfreeze, freeze, and refreeze their resources, similar to that of the three-staged model of change (Lewin 1951). As such, innovation with digital technologies is said to be notoriously challenging and dynamic. Furthermore, innovation with digital technologies entails multiple and simultaneous adjustments in resources, staffing, culture, decision-making, communication, and reward systems (Lokuge et al. 2018b; Nambisan and Sawhney 2011; Sirmon et al. 2011). Moreover, the non-exclusivity of digital technologies, where the competitors can emulate IT innovations (Nylén and Holmström 2015), means that organizations must be able to change their resources and strategy configurations continuously to attain a competitive advantage (Avedillo et al. 2015). It is also important to note that the digitization success stories (e.g., Booth et al. 2016) have demonstrated that not only the modernity of technologies but also the IT decision-makers and organizational culture play a crucial role in implementing innovations (Nylén and Holmström 2015; Swanson and Ramiller 2004; Weill and Vitale 2002).

The limited insights in research, substantial potential to innovate using digital technologies, and the danger of not innovating in competitive markets motivate this study. As such, the current paper is one of the first studies to scientifically assess organizational readiness for digital innovation. The objective of the study is, therefore, to derive a robust, validated organizational readiness for digital innovation model that is simple, yet generalizable, and allows useful and pragmatic assessment. Focusing on developing a composite construct to assess organizational readiness for digital innovation, this study employs both qualitative and quantitative research methods. The qualitative study (labeled as study-1) provides rich context specificity (Isabella 1990) to derive the a priori measures necessary for the quantitative study (labeled as study-2). A well-focused quantitative assessment using a formative, additive, and parsimonious multidimensional organizational readiness construct for digital innovation is the focus of study-2. Such a validated construct would facilitate cumulative research on digital innovation, while providing a benchmark for organizations to track their readiness to exploit digital technologies.

The paper proceeds in the following manner. First, the paper provides the theoretical foundation and outlines the scope of the study. Next, it describes the qualitative study (study-1) that was conducted to derive the a priori model of organizational readiness for digital innovation construct. The derivation of the a priori model of the study is described next. Subsequently, the paper introduces study-2, the quantitative approach designed to test the a priori model. The results of the study are described, drawing conclusions for research and practice, and finally, the concluding section summarizes the limitations of the study.

Theoretical Foundations

Crossan and Apaydin (2010, p. 1155) state that innovation is a “production or adoption, assimilation and exploitation of a value-added novelty in economic and social spheres; renewal and enlargement of products, services and markets; development of new methods of production; and establishment of new management systems.” Following recent work on digital innovation (e.g., Henfridsson et al. 2014; Yoo et al. 2012), this study proposes digital innovation as innovation enabled through or triggered by digital technologies. The Crossan and Apaydin (2010) definition affirms that innovations in “everyday organizations” go beyond the definitions that idealize innovation only as “new to the world” (e.g., Garcia and Calantone 2002). Moreover, their definition resonates with the anecdotal commentary that digital technologies facilitate innovations in everyday organizations. Further, this definition highlights the importance of organizational readiness, such as continuous change of its resources, procedures, and strategies. The key terms in their definition – production, adoption, assimilation, exploitation, renewal, enlargement, and development – all suggest that innovation can be made only when the organization is ready to change its innovation approach continuously. As such, an organization with the abilities to unfreeze, freeze, and refreeze their resources and strategies according to the dynamic environments will survive the current hyper-competitive markets (Sirmon et al. 2007).

The terms "readiness" and "innovation" have been studied under two primary views: (i) the readiness of an organization to withstand an innovation and (ii) the readiness of an organization to deliver or enable innovation. This study focuses on the latter, evaluating an organization's readiness to innovate with digital technologies. The concept of organizational readiness for innovation has received only limited attention in the literature (Snyder-Halpern 2001). An extended discussion on readiness to innovate as a broader notion is provided in Appendix B. Appendix B highlights that (i) readiness is a *state* that is attained *prior* to the commencement of a *specific* activity in relation to psychological, behavioral, and structural preparedness of organizations (Helfrich et al. 2011); (ii) readiness can be observed from multiple levels and then be analyzed at the individual, team, department, or organization level (Grover et al. 1999; Molla et al. 2009); and (iii) readiness is best conceptualized as a degree of readiness in a continuum, rather than as a dichotomous variable of being "ready" or "not ready." As such, organizational readiness for digital innovation is not a homologous construct (Klein and Kozlowski 2000). It is a construct that has a different meaning, measurement, and relationship with other variables across different levels of analysis (Weiner et al. 2008; Weiner et al. 2009). In this study, innovation is observed at the organizational level. Therefore, this study defines organizational readiness for digital innovation "*as an organization's assessment of its state of being prepared for effective production or adoption, assimilation and exploitation of digital technologies for innovation.*"

The theory of organizational readiness for change (abbreviated henceforth as the "readiness theory") provides the overarching theoretical scaffold to develop an assessment of organizational readiness for digital innovation. While the readiness theory has been widely used in academics (with over 870 citations since 2009, as of September 1, 2018), no prior studies have focused specifically on organizational readiness for digital innovation. While it is acknowledged that there are many factors that affect the production or adoption, assimilation, and exploitation of digital innovation, theoretical boundaries of the readiness theory are applied to derive the a priori constructs of the readiness model.

According to the readiness theory, and consistent with the proposed views, "readiness for change" is a precursor to the successful implementation of complex changes. Specifically, organizational readiness for change refers to organizational members' change commitment and change efficacy to implement organizational change (Weiner et al. 2008; Weiner 2009; Weiner et al. 2009). According to Weiner (2009), organizational readiness for change indicates a state of being both psychologically and behaviorally prepared to take action (i.e., willing and able). Being ready for innovations is nontrivial (Nelson and Winter 1977). Drawing from organizational change literature, it is postulated that organizations produce or adopt, assimilate, and exploit innovation if the changes are (i) perceived as necessary (willingness) and (ii) the organization has the required capabilities (ability) (Armenakis et al. 1993; Teng et al. 1998). More specifically, the readiness theory provides the underpinnings to derive appropriate constructs for organizational readiness for digital innovation by conceiving them through (i) change valance, (ii) change efficacy, and (iii) contextual factors.

Change valance captures the commitment to change. Drawing from the motivation theory (Fishbein and Ajzen 1975; Meyer and Herscovitch 2001), Weiner (2009, p. 70) argues that "…the more organizational members value the change, the more they will want to implement the change, or, put differently, the more resolve they will feel to engage in the courses of action involved in change implementation." Change valence argues for the urgency, support, and commitment that employees have for change. While it is acknowledged that various reasons may influence an employee's commitment for change, change valance observes whether members of an organization collectively value the change for its implementation.

According to Gist and Mitchell (1992, p. 184), change efficacy is a "comprehensive summary or judgment of perceived capability to perform a task." Weiner (2009, p. 71) notes that "implementation capability depends in part on knowing what courses of action are necessary, what kinds of resources are needed, how much time is needed and how activities should be sequenced. In addition to gauging knowledge of task demands, employees also cognitively appraise the match between task demands and available resources." As such, the assessment of change efficacy encapsulates the assessment of the adequacy of human, financial, material, and informational resources necessary to implement the change. It is noted that efficacy is a leading indicator of organizational readiness. Compared to lagging indicators (e.g., efficiency) that focus on how well they have been executed as a postmortem, efficacy allows organizations to assess the potential capabilities of organizational readiness to innovate with digital technologies.

Contextual factors provide a broader notion that influence digital innovations. Scholars have highlighted various factors that affect readiness for change. For example, some scholars highlight the importance of organizational culture that promotes change (Jones et al. 2005), while scholars such as Weeks et al. (2004) highlight the importance of learning requirements for organizational change. It is argued that an organization with a culture that favors innovation and learning has greater readiness for change (Jones et al. 2005; Weiner 2009). Moreover, some scholars highlight the importance of flexible organizational strategies, partnerships (e.g., good working relationships), and organizational procedures in promoting readiness for change (Benitez et al. 2018b; Rafferty and Simons 2006).

The three theoretical paradigms, namely, change valance, change efficacy, and contextual factors, provide the study with a guided scope to derive the appropriate subconstructs and measures that are necessary for organizational readiness for digital innovation model.

Research Design

In employing the theoretical underpinnings for the new study context of digital innovation, this study followed the established guidelines of instrument development stages (i.e., item creation, scale development, and instrument testing) espoused by Moore and Benbasat (1991) and detailed by MacKenzie et al. (2011). The item creation and scale development stages were completed using a qualitative study (henceforth referred to as study-1). Instrument validation was done using a quantitative survey (referred to as study-2). Figure 1 illustrates the specific process followed by this study in study-1 and study-2.

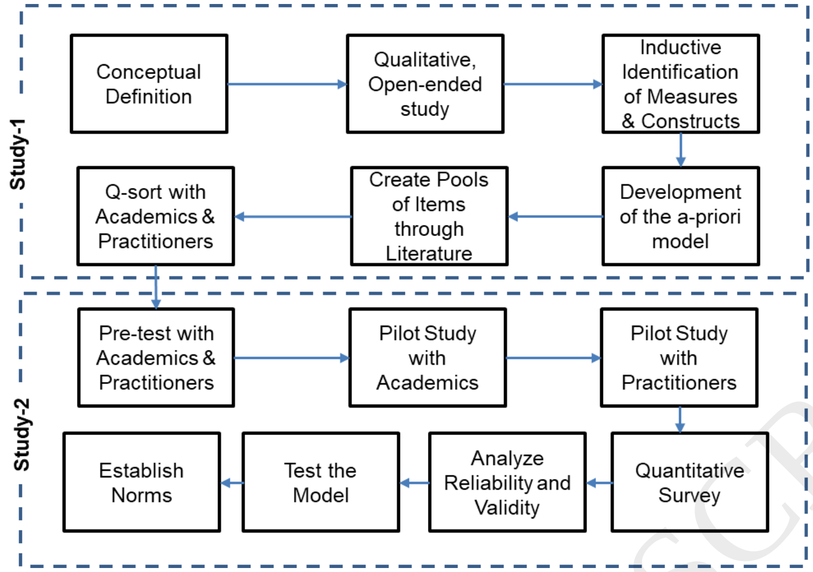

Figure 1: Research Design

Study-1: Deriving the a priori model

The readiness theory guides the scope of study-1. Study-1 aims to generate a set of starting subconstructs (and measures) for the three theoretical paradigms of the readiness theory: change valance, change efficacy, and contextual factors. Following the guidelines[1] of Hinkin (1995) and Hunt (1991), this study strives to develop a good formative construct – one that exhausts the entire domain of the construct completely, meaning that the constructs should collectively represent all the relevant aspects of the variable of interest (Bagozzi and Fornell 1982; Bagozzi and Phillips 1982; Fornell and Bookstein 1982; Gable and Sedera 2009). Its purpose, akin to the function phase of the Burton-Jones and Straub (2006) approach, is to justify the salient a priori attributes relating to organizational readiness for digital innovation. While a common approach to identify a priori subconstructs is to select from the existing literature, the substantial differences in traditional versus digital innovations outlined above warranted an inductive approach. This approach was advocated when the constructs were adapted to new contexts that have not been validated before (Burton-Jones and Straub 2006; Sedera et al. 2017). The approach in study-1 ensures that the referent construct is not only conceptually but also empirically relevant to the study context.

[1] As noted by Hinkin (1995), this step further enhances the content validity of the measures employed, as this process allowed the study to refine and/or replace items before preparing and administering a questionnaire. According to Hunt (1991), an inductive approach is used, also called as "grouping", or "classification from below" is appropriate when the theory is extended to a different or new context.

Study-1 consists of a field study of nine case organizations. The sample participants included nine chief information officers (CIOs) (or their equivalent position) and one line-of-business manager (LOB manager) and two additional respondents representing each organization. Appendix C provides the details of the nine organizations and their respondent sample. Interviews were conducted as individual, face-to-face, semi-structured, which lasted between 40 and 60 minutes each. In total, the interviews transcribed to approximately 24 hours and 45 minutes. Two nonprobability sampling techniques, purposive and snowball, were used in the selection of the interview participants to ensure that they were appropriate opinion leaders (purposive sampling) with well-developed views on the research topic (Minichiello et al. 1995). According to Laforet (2013), when measuring innovation, observations must be made from managers who initiated or were immediately affected (snowballing sampling) by the innovative endeavors for the purpose of corroboration, triangulation, and substantiation. As such, in addition to CIOs, LOB managers were selected as the lead representatives of innovation projects, which were initiated 6 months before data collection. Given the generative purpose of the interview, the sample size did not have to be large because "the validity, meaningfulness and insights generated from qualitative inquiry have more to do with the information-richness of the cases selected and the analytical capabilities of the researcher than with sample size" (Patton 2002, p. 185). At the beginning of the meeting, the participants were briefed about the objective of the study. The overarching question in study-1 was "*Can you describe the salient factors helping or hindering digital technology-led innovations in your organization?*"

The word "readiness" was purposely avoided in the question to minimize biases in party-line responses. Moreover, instead of asking for helping factors, it was decided to include hindering factors to the question, thus arguing that only the inclusion of both positives and negatives can increase the representativeness of the readiness factors. A series of follow-up questions sought clarifications and additional information facilitated through the open-ended nature of the interviews. Study-1 yielded a total of 830 open codes. Decomposition of the textual responses of the transcripts was straightforward, simply involving the extraction of contiguous phrases, without modification. Statements of negative connotations were converted to positive statements, using antonyms.

First, the open codes were mapped into the three theoretical paradigms of the readiness theory. Change valance was found in 86 codes (11% of the total codes), change efficacy in 453 codes (59% of the total codes), and contextual factors in 235 codes (30% of the total codes). The substantial number of citations mapped into the three theoretical paradigms demonstrated the relevance of the readiness theory to the new research context of digital innovation and the appropriateness to employ them to derive the a priori model (subconstructs and measures). Next, by an inductive approach, subconstructs and measures of organizational readiness for digital innovation were sought. The inductive approach allowed contextually sensitive measures to be developed, without relying on omnibus measures (Burton-Jones and Straub 2006). To minimize individual errors of judgment, two researchers participated in the mapping exercise, with each person mapping the open codes and comparing the results. Comparison of the individual classifications revealed an average inter-coder agreement of 80%[2]. Discrepancies were discussed until a consensus was reached, and formal criteria for classification were documented. Table 1 presents the seven subconstructs with their 21 measures, where the number of codes derived per subconstruct is provided within bracket. It also shows the number of open codes derived from interviews of the LOB managers and CIOs and the percentage for each measure as a fraction of total codes. It is important to note that measures with less than 2% of the total codes were omitted to maintain model parsimony. The omitted citations did not map into any of the existing subconstructs or warranted creating new subconstructs. The unmapped open codes that were excluded from the model include (i) resource affordability with seven citations, (ii) world infrastructure with nine citations, (iii) equal employment conditions with nine citations, (iv) government legislations with nine citations, (v) national values with nine citations, (vi) leadership with eight citations, and (vii) political stability with five citations. The seven subconstructs, drawn through the theoretical views described above and their measures instantiated through an inductive round, purport to provide a distinct, different, yet complete perspective of organizational readiness for digital innovation.

[2] Krippendorff (1980) recommends inter-coder reliability of at least 70%.

Theme / Citations	CIO	LOB	%	Sample Quote
…attitude (28)	17	11	4%	*we have less resources, but our attitude is always positive - CIO#4*
…psychological motivation (26)	17	9	3%	*staff are willing to pick-up tough assignments - CIO#5*
…empowered (32)	17	15	4%	*decisions are made within departments… - LOB#16*
…flexible financial (64)	38	26	8%	*I have a flexible budget based on projects - LOB#6*
…flexible human resources (57)	32	25	7%	*we can hire short-term, project-based IT staff - CIO#7*
…flexible infrastructure (47)	30	17	6%	*most of our systems are now on cloud - CIO#5*
…stability of the ES (59)	36	23	8%	*all efforts must be made to make the ES steady - LOB#4*
…digital tech availability (61)	20	41	8%	*we should have a feast of new technologies - CIO#7*
…infrastructure stability (37)	28	9	5%	*it's all ugly if we can't have infrastructure supporting things - LOB#1*
…knowledge (41)	19	22	5%	*core knowledge we need are…tech, process and organizational - CIO#1*
…skills (52)	27	25	7%	*staff must be skilled in core tech stuff - CIO#2*
…adaptability (35)	18	17	5%	*three major projects of multiple tech types…staff must be adaptable - CIO#4*
…sharing ideas (27)	18	9	3%	*when there is a new project, I bring all departments to a forum - CIO#2*
…decentralized decisions (14)	8	6	2%	*I commissioned this project for my department - LOB#3*
…risk aversion (41)	28	13	5%	*risk is something inherent in all projects, not a show-stopper - CIO#1*
…clarity of goals (16)	7	9	2%	*every goal must be clear, precise… - CIO#8*
…relevance of goals (17)	8	9	2%	*if we have to follow goals, then they have to be relevant - LOB#1*
…communicating goals (13)	6	7	2%	*all departments must know our strategic direction - CIO#6*
…software vendor (30)	18	12	4%	*most projects are done jointly with the software vendor - CIO#9*
…management consultant (44)	26	18	6%	*we had 2 consulting companies putting bids for this - CIO#2*
…customer/supplier (33)	16	17	4%	*nowadays, we have to work closely with our suppliers in all solutions - LOB#13*

Table 1: Mapping results of study-1

Next, the content validity was established by observing the degree to which each dimension reflects (the operationalizing measure) its nominated subconstruct. Measurement representativeness, comprehensiveness, and clarity were established by the Q-sort approach following suggestions of Grant and Davis (1997)[3].

Deriving the a priori model

Results of study-1 helped to develop the a priori model of organizational readiness for digital innovation (and its subconstructs and measures). The specification of a parsimonious a priori model involved (i) elimination and consolidation of measures, (ii) introduction of new domains or measures, and (iii) revisiting the relevance of the domains identified in study-1. There were concerns about the "strategic readiness" theme purely due to its low citation count. Yet, instead of eliminating, it was retained in the a priori model to be tested using quantitative data in study-2. Figure 2 depicts the a priori model of organizational readiness for digital innovation. It includes seven subconstructs and the associated measures derived from study-1. The seven subconstructs of the a priori model of organizational readiness for digital innovation are all conceived and measured as a formative composite construct[4]. Benitez et al. (2017, p.2), drawing from the works of past research (Dijkstra and Henseler 2015; Henseler et al. 2014; Henseler et al. 2016; Rigdon et al. 2010), state that "composite models/constructs are formed as linear combinations of their respective indicators." They also argue that "a composite construct serves as proxy for the concept under investigation (i.e., the recipe) that is composed of a mix of indicators (i.e., the ingredients)."

The a priori model subconstructs (i) need not covary, (ii) are not interchangeable, and (iii) cause the core construct as opposed to being caused by it. In addition, the subconstructs may respond to different antecedents and consequences for potentially different nomological networks (Cenfetelli and Bassellier 2009; Jarvis et al. 2003; Petter et al. 2007). Henseler et al. (2016) specify that composite constructs such as organizational readiness for digital innovation can be employed to conceptualize, operationalize, and estimate emergent, strong, complex, and "man-made" (or "organization-made") concepts.

[3] The approach followed here is analogous to the Q-sort approach suggested by Kendall et al. (1987) for attaining content validity.
[4] Benitez et al. (2017, p. 2) demonstrate two types of measurement models that PLS path models can contain: Factor models and composite models. "*Factor models use reflective constructs and assume that the variance of a set of indicators can be perfectly explained by the existence of one unobserved variable and individual random error.*" Henseler et al. (2016) suggest that factor models are best to model behavioral concepts as personality traits, individual behavior, and individual attitude.

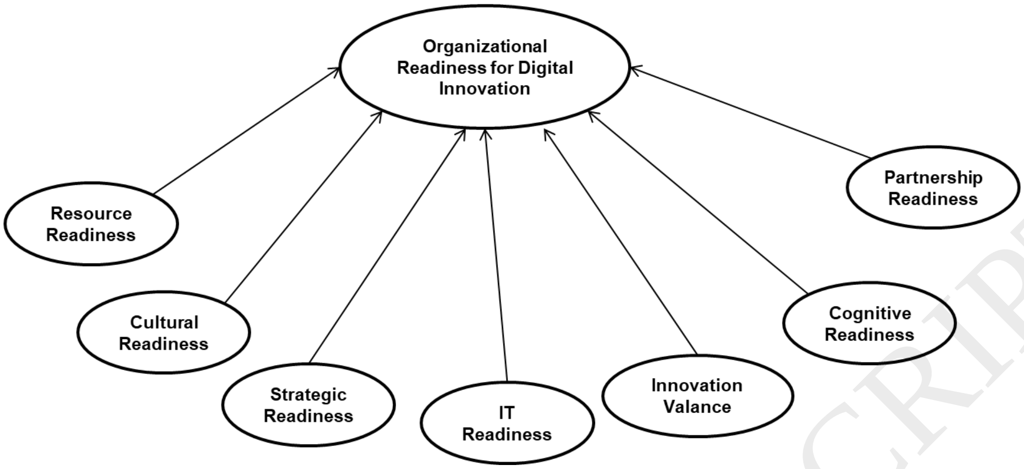

Figure 2: The a priori model of organizational readiness for digital innovation

As mentioned, a formative composite construct matches the study objective of specifying a construct, where its subconstructs are parsimonious, mutually exclusive, and additive to yield the overarching construct. The formative construct of organizational readiness for digital innovation does not purport (is not concerned with) any causality among the constructs. Herein, it is acknowledged that some studies may causally relate similar subconstructs with organizational readiness, wherein the intention was not to derive a composite measure of organizational readiness. For example, Tarafdar and Gordon (2007) causally relate resource availability with innovation, while Fan (2006) demonstrate causality between leadership and innovation. Such studies did not propose a composite model, rather simply observed a causal (or process) relationship that a subset of variables had on innovation. This snapshot or cross-sectional approach is at times criticized, where the intent of research is to test causality (because it does not technically test for temporality[5]); however, in the case of organizational readiness for digital innovation model, a snapshot of the system is precisely what is sought. Furthermore, the conception of the constructs as formative is particularly useful so that they provide the "specific and actionable attributes" (Mathieson et al. 2001). The seven subconstructs, as derived from the inductive exercise, are described below and arranged according to the descending order of the number of citations. The

[5] One variable should empirically precede the other in temporal order.

discussion provides a summary, the theoretical understanding, sample quotations from the participants, and how each of the subconstructs and measures were developed.

Resource Readiness

While the term "resource readiness" has been employed for brevity, it firmly emphasizes on the "flexibility" that the organization has to configure and reconfigure its resources in order to facilitate the needs of digital innovation. The construct is defined as the flexibility of a shared set of financial, technology, and human resources that provide the foundation on which digital innovation can be delivered upon. Here the emphasis is on flexibility rather than on availability. By understanding the flexibility of financial, technology infrastructure, and human resources, this study extends similar notions on flexibility proposed in prior IS studies (e.g., Kim et al. 2010).

This study received a total of 165 citations and yielded three distinct measures, namely, financial flexibility, human resource flexibility, and technology infrastructure flexibility. Overall, resource readiness highlights the importance of the flexibility of resources to change the assembly of IT to sense-and-respond to the dynamic markets (Chen et al. 2017; Happ 1996; Pennings and Buitendam 1987). Such resources are not only limited to financial but also include human capital and IT infrastructure, which are all considered as determinants of innovation. Innovation with digital technologies has substantial reliance on the flexible IT infrastructure and mobility of human capital, consistent with the views of established literature (Chen et al. 2017; Lokuge and Sedera 2014b; Zaltman et al. 1977).

The financial flexibility was echoed in all cases. Tellingly, the respondents highlighted the dire consequences of rigid financial resource allocations.

> *"It's not how much you have… it's what you can do with it. If you are going to tie dollars to projects at the start of a financial year, then it stops us from innovating" CIO#4*

Similarly, effective innovation implementation requires flexibility in redeployment and reskilling of employees. The importance of these factors for digital innovation was highlighted.

> *"The first thing I look at in staff is how adoptable they are to changing environments" LOB #11*

Study-1 data show that organizations are willing to try and experiment with IT hardware and software obtained from subscribed service models. Further, as Chen et al. (2015) highlight, the flexibility of the IT infrastructure allows the organization to develop innovations much faster than hosting technologies on premise.

"We have all sorts of new IT. We don't buy them, mostly are from Amazon or Rackspace" CIO#1

Three measures derived from the induction have parallel notions in the literature that further strengthens their inclusion in the a priori model: (i) flexible financial resources (Oke et al. 2012; Popadiuk and Choo 2006), (ii) human resources (Im et al. 2013), and (iii) flexible infrastructure resources (Byrd and Turner 2001; Chen et al. 2015). Note that the emphasis of the infrastructure herein is about the flexibility of such technology resources, as opposed to its availability (which is discussed below).

IT Readiness

IT readiness is defined as the strength of the IT portfolio to facilitate digital innovation. IT readiness received 157 citations. More specifically, study-1 highlights the stability of the enterprise system and its salient role in digital innovations. All the nine cases touted the importance of the enterprise system for conducting their core business processes such as financial accounting and human capital management and highlighted that digital technologies can be an advantage only when the enterprise system is stable. The stability of the enterprise system, which influences the innovation capacity of digital technologies, was highlighted in a recent study by Sedera et al. (2016). Further, according to Chen et al. (2017), organizations that use IT to support core competencies will experience improved strategic flexibility, which may lead to innovation and increased performance.

"Nothing can be done if SAP [enterprise system] is unstable" – CIO#1

Furthermore, the participants outlined the importance of accessibility to digital technologies. The on-demand and subscription nature of cloud, wearables, mobile, social media, and business analytics (Lokuge and Sedera 2014a; Nambisan 2013; Yoo et al. 2012) is considered as an important readiness factor for innovation.

"The whole world is moving to cloud, mobile and social media. We have many of these available on subscriptions" – CIO#5

The IT infrastructure readiness, especially in maintaining a secure and stable environment, was also mentioned by the participants.

"Security and stability comes from up-to-date blades and racks. For our industry sector, they are very important. That's why we invest a considerable amount on the infrastructure" – CIO#7

Three measures were developed to measure the IT readiness, employing (i) stability of the enterprise system (Chen et al. 2017; Lokuge et al. 2016b; Sedera et al. 2016), (ii) availability of digital technologies (Nylén and Holmström 2015; Sedera et al. 2016), and (iii) stability of the IT infrastructure (Tilson et al. 2010; Tilson et al. 2012).

Cognitive Readiness

Cognitive readiness is defined as the strength of the knowledge base in an organization in facilitating digital innovation. Study-1 yielded 128 citations for cognitive readiness. The participants identified that knowledge, skills, and adaptability of the staff are the core readiness facets for digital innovation. Study-1 participants identified that knowledge of the business processes and software is an important aspect of readiness. These types of knowledge identified by the participants are consistent with the past literature (Rose et al. 2016; Sedera and Gable 2010). They noted that such characteristics may be of special relevance and significance for organizations that must adapt quickly to rapidly emerging, unforeseen challenges. Both individual and organizational units can be prepared to perform necessary tasks.

"Knowledge of the software, business processes and competitor environment are crucial" – CIO#8

The participants also highlighted that the technical skills of the IT staff are essential for initiating digital innovation. Similarly, prior research highlights the importance of skills of the IT staff for innovation (Byrd and Turner 2000).

"At the end of the day, we have to have the core technical skills to deliver solutions" – CIO#6

Furthermore, the adaptability of the staff for technical and organizational changes was also outlined as important for delivering digital innovation. It is important to note that cognitive readiness is different from the subconstruct "human resource" (under resource readiness construct): cognitive readiness focuses on the adequacy of the knowledge bases while human resource focuses on the flexibility of human resources.

"…the only thing permanent now is 'change.' So, we need adaptability in all staff" – CIO#9

Three measures were developed to measure the cognitive readiness using the adapted instruments of Gist and Mitchell (1992), Sedera and Dey (2013), and Lamb and Kling (2003) to gauge (i) knowledge, (ii) skills, and (iii) adaptability of the employees.

Partnership Readiness

Partnership readiness is defined as the affiliation of external stakeholders to an organization's digital innovation. It received 107 citations, attributing to three kinds of partnerships necessary for digital innovation. The cases highlighted the importance of initiating and maintaining relationships with vendors, consultants, and customers as an important facet of digital innovation. This was further established from the literature that especially for digital innovation, organizations seek assistance from a wide spectrum of partners including software and hardware vendors, consultants, suppliers, and even customers (Abrell et al. 2016; Benitez et al. 2018b; Ceccagnoli et al. 2012; Gawer 2014). For example, Abrell et al. (2016) highlight the distinct roles of customers and users in supporting digital innovation. Similarly, study-1 case participants demonstrated a strong reliance on the networked partner engagement of multiple software and vendors in rapid solution developments.

> *"We have a great relationship with SAP. It is not just SAP then we have, we have their army of developers as well. In most cases, they also have their ecosystem as well" – CIO#5*

Similarly, consulting companies also play a pivotal role in making the organization innovation ready (Sedera et al. 2014; Weeks and Feeny 2008). Their role was especially evident in delivering substantial technology solutions for reasonably long periods of time.

> *"Consultants are best for projects that are over 6 months and budgets over $2 million" – CIO#4*

Finally, the participants outlined customer and vendor partnerships that are essential for developing collaborative innovations. All the cases had at least two such innovations initiated or completed during the period of data collection.

> *"Innovations alone won't work. We have to have partnerships with customers/suppliers" – CIO#7*

The partnership readiness included three measures: (i) IT vendor relationship (Ceccagnoli et al. 2012; Tate et al. 2013), (ii) relationship readiness with management consultants (Bessant and Rush 1995; Subasingha et al. 2012), and (iii) readiness for establishing partnerships with customers or vendors (Benitez et al. 2018b; Lubatkin and O'Neill 1987; Teo and Bhattacherjee 2014; Walther et al. 2018).

Innovation Valance

The innovation valence concept is adapted from the change valence concept. Innovation valance measures the positivity the stakeholders have toward digital innovation. It was derived using 86 citations. It alluded to the (i) attitude, (ii) motivation, and (iii) empowerment that the employees have for digital innovation. Research highlights that positive attitudes of the employees foster open-ended creativity, which is a key driver for digital innovation (Lokuge et al. 2018a; Mueller et al. 2013). Similarly, motivation is one of the salient attributes that encourages open-ended value creation, especially in demanding circumstances (Berlyne 1965; Ryan and Deci 2000). Motivational attitude is a psychological state that allows organizations to overcome deficiencies in resources such as finance and human capitals.

"We work as one team until we deliver the solution necessary." – LOB#18

Psychological motivation facilitates exploratory behavior observed through thinking, learning, and behaving beyond expectations, which are fundamental in delivering innovations through digital technologies (Antikainen et al. 2010; Sauer and Yetton 1997; Zack 2003).

"If your staff can pick up work not just for the sake of work, but with passion, then you can deliver any innovation" – LOB#11

Furthermore, it was found that the leaders motivate staff to be empowered to make better decisions and commit beyond their traditional boundaries.

"We maximize empowerment…it is within boundaries, but making them empowered motivates them to take ownership of our projects" – CIO#2

Three measures were developed to measure change valance using (i) attitude of the employees (Damanpour and Schneider 2006; Evanschitzky et al. 2012), (ii) motivation (Antikainen et al. 2010; Damanpour 1991), and (iii) empowerment (Ecker et al. 2013; Mate-Sanchez-Val and Harris 2014).

Cultural Readiness

Cultural readiness is defined as the strength of the core values of an organization that facilitates digital innovation. It was derived using 82 citations. Organizational culture is highlighted as a crucial factor for any innovation (Damanpour 1991; Jansen et al. 2006; Sedera et al. 2001). The recent literature argues that organizational culture is the most salient factor for innovation in organizations that thrive in the digital economy (Lee et al. 2016). Companies such as Google, Apple, and Facebook have strong organizational cultures that promote innovation

(Boudreau and Lakhani 2013; Jana 2013). For example, Lashinsky (2011) in Fortune magazine describes Apple as the "world's biggest start-up," describing the conducive culture at Apple Inc. for innovation.

Study-1 highlighted that contemporary organizations must be engaged in an innovation-savvy culture. The nine cases highlighted that a culture that promotes (i) sharing ideas, (ii) decentralized decision-making, and (iii) low-risk aversion will have positive effects on digital innovation. Moreover, they identified that factors such as the proliferation of social media, digital natives in the workplace, and smart mobile phones further promote the creation of vibrant organizational culture assisting digital innovation (Benitez et al. 2018a; Büschgens et al. 2013).

"All ideas are shared on Yammer…then people start discussing the best ways delivering it" CIO#5

Some case participants argued that a culture of decentralized decision-making helps organizations to implement innovations faster.

"The decision-making delays were the worst, we now have a flat culture" – LOB#7

Cases suggested that the risks in technology solutions delivering innovations are mostly modest and that a complete failure is almost impossible (Patanakul et al. 2012; Robeson and O'Connor 2013). The low risk in digital technologies is further assisted by the low cost of digital technologies and their trialability.

"The management must be able to trust us. IT is now much safer and cheaper and we trial before we even commit to a solution now" – CIO#9

Three measures were used to collect information on innovation savvy culture: (i) sharing of ideas in a connected workplace (Patanakul et al. 2012; Shane et al. 1995), (ii) decentralization of decision-making culture (Ford and Gioia 2000; Lengnick-Hall 1992), and (iii) risk aversion (Larson and Gobel 1989).

Strategic Readiness

Strategic readiness is defined as a set of managerial activities that an organization engages in to facilitate digital innovation. Forty-six citations were mapped to the strategic readiness subconstruct. Strategic readiness provides the knowledge that communicates a plan of actions and forms the guidelines for compliance in digital innovation. A poor understanding of the details of such changes and unsureness of what is expected have been found to be prominent but often unrecognized factors in unsuccessful innovation projects. Studies discuss the importance of clarity, continuous refinement, and communication of strategic goals (Bharadwaj et al. 2013; Grover and Kohli 2013; Nylén and Holmström 2015).

"Any IT must always try and align with strategic goals. That's the way to innovate" – LOB#14

Communicating strategies with all relevant staff was also deemed important for digital innovation.

"New ideas [coming from digital technologies] must cleave around the strategic goals…and all staff must know them" – CIO#3

As mentioned earlier, there were reservations about whether this is more related to ideation. Yet, in the interest of inclusion, three measures were developed and included to the a priori model: (i) the clarity of goals (Greenhalgh et al. 2004; Oke et al. 2012), (ii) relevance (Damanpour 1991; Robeson and O'Connor 2013), and (iii) strategy communication (Backmann 2013; Evanschitzky et al. 2012).

Study-2: Measurement of organizational readiness for digital innovation

The purpose of study-2 is to further test the a priori model of organizational readiness for digital innovation on the basis of subconstructs and measures derived from study-1. Having derived the subconstructs using the readiness theory, measures derived inductively, a survey instrument was devised to operationalize the 21 measures under the seven subconstructs (see the complete instrument in Appendix D). The instrument was pilot tested with a sample of 26 senior IT managers, who attended a monthly CIO business seminar series organized by a coauthor. The pilot survey analysis resulted in the addition of some explanatory statements. For example, there was a concern about whether the readiness to innovate relates to the *organization* or to the *individual* who is responding to the survey. As such, a new statement was added instructing the respondents as follows: "This survey measures *the innovation readiness of your organization.*" The survey instrument was then circulated among representatives of 350 organizations at a renowned international CIO forum in November 2014. The event organizers indicated that all participating organizations were large and were representative of all industry sectors. Further, the survey instrument captured demographic details to assert that the organizations considered for the analysis possessed the following criteria: (i) the organization had a dedicated CIO/CTO and a team of IT staff that managed the IT portfolio, (ii) the organization had used a portfolio of technologies for the past 5 years and documentation of the IT roadmap since the implementation of the enterprise system was available, and (iii) at the time of the data collection, the CIO had been in the position for at least 6 months, was not in the last 6 months of their appointment[6], and was participating in regular meetings with the executive leadership team (e.g., Chief Executive Officer and Chief Finance Officer).

The sample of both CIOs and LOB managers was appropriate for the study objectives, as these personnel would be able to comment knowledgeably on behalf of the organization or department in relation to innovation with IT portfolio (Grover et al. 1993). The CIO and LOB managers are involved in the information resources that influence organizational strategy and have the direct responsibility for the planning of the IT framework necessary to cope with an organization's competitive environment. Matching responses from 189 organizations were selected for the analysis. They included 189 CIOs and corresponding 189 LOB managers from each organization, yielding a total respondent sample of 378. The 378 respondents provided answers to all questions of the survey conducted in study-2. Table 2 depicts the details of the respondent sample.

Characteristic	Frequency		Characteristic	Frequency	
Gender	**CIO**	**LOB-manager**	**Title**	**CIO**	**LOB-manager**
Male	159	127	CIO	94	N/A
Female	22	40	CTO	23	N/A
Unreported	8	22	Director of IT	65	N/A
Experience	**CIO**	**LOB-manager**	VP of IT	7	N/A
<1 year	6	0	LOB-manager	N/A	189
1-5 years	21	53	**Firm Type**		
6-10 years	126	113	Private	128	
11-15 years	25	21	Public	61	
16+ years	11	2	**Industry Type**		
Reporting Status			Manufacturing	86	
Report to CEO	145		Service	53	
1 level to CEO	32		Other	50	
2 levels to CEO	49 (inc 37 LOBs)				
2+ levels to CEO	152				

Table 2: Demographic details of the respondent sample of study-2

[6] This was essential to determine that the present IT leadership was not "in transit." This is an important consideration because it has been argued that firms with in-transit CIOs do not embark on strategic initiatives.

Data Analysis

The analysis herein employs partial least squares (PLS) structural equation modeling (SEM) method. The study analysis follows the guidelines of Benitez et al. (2017) and Benitez et al. (2018b). The model and construct validation in this research are reported under five headings: (i) content validity, (ii) confirmatory composite analysis, (iii) construct validity, (iv) testing the measurement model, and (v) demonstrating the strength of the structural model (observing the additivity and nomological net test). The PLS-SEM is a technique that is commonly employed in the IS field, which has the capacity to evaluate complex research questions by estimating a complex research model, modeling latent variables, and estimating several types of measurement errors. PLS-SEM is therefore well suited for highly complex predictive models, which supports the mapping of formative observed variables (Becker et al. 2012; Henseler and Sarstedt 2013; Sedera et al. 2003; Wold 1989). Further, as suggested by Diamantopoulos and Winklhofer (2001, p. 272), organizational readiness for digital innovation construct was measured by two global items that "summarize the essence of the construct that the index purports to measure" and examine the extent to which the items associated with the construct correlate with these global items. To test the measurement and structural models, ADANCO 2.0.1 software was employed (Dijkstra and Henseler 2015) with the bootstrap resampling method (4,999 resamples). Following the guidelines of Dijkstra (2010), the seven subconstructs were estimated by using the regression weights (mode B).

Content Validity

Because the subconstructs and measures were derived inductively for organizational readiness for digital innovation, the establishment of content validity was a priority. The current study followed the guidelines of McKenzie et al. (1999) for establishing content validity, which entailed four steps[7]: (i) using the guidelines proposed by Lynn (1986), an initial draft of the survey instrument was created by canvassing the related literature to derive its measures; (ii) following the guidelines of the American Educational Research Association (2002), a panel of respondents was established to review and evaluate the possible survey questions, ensuring that the panel had the necessary training, experience, and qualifications; (iii) the panel critiqued the survey measures;

[7] The four-step approach followed here is analogous to the Q-sort approach for attaining content validity (Kendall et al. 1987; Tractinsky and Jarvenpaa 1995).

and (iv) the panel conducted a review of the questionnaire, assessing how well each item represented each of the seven subconstructs. The panel of experts included six CIOs and four LOB managers of study-1. In this fourth step, a quantitative assessment was made, thus establishing the content validity ratio (CVR) for each item/question using the formula proposed by Lawshe (1975). On the basis of the pilot tests, a minimum CVR value of 0.79 was observed at a statistical significance of $p<0.05$. Feedback from the pilot-test respondents resulted in minor modifications to the wording of the survey items and endorsement of the research model and its seven subconstructs and associated measures (Lawshe 1975; Lynn 1986; McKenzie et al. 1999).

Confirmatory Composite Analysis

The assessment of the measurement model commences with a confirmatory composite analysis with the objective of evaluating the overall fit of the saturated model (Henseler 2017; Henseler et al. 2016). A confirmatory composite analysis helps to understand whether it makes sense to create the proposed formative construct and detects model misspecification (Henseler et al. 2014). According to Henseler et al. (2014) and Benitez et al. (2017), the confirmatory composite analysis checks the adequacy of the composite model by comparing the empirical correlation matrix with the model-implied correlation matrix by examining the standardized root mean squared residual (SRMR), unweighted least squares (ULS) discrepancy (d_{ULS}), and geodesic discrepancy (d_G) to evaluate goodness of saturated model fit (Henseler et al. 2014). These measures of goodness of fit evaluate the discrepancy between the empirical correlation matrix and the model-implied correlation matrix (Benitez-Amado and Ray 2012; Benitez et al. 2016; Dijkstra and Henseler 2015; Hu and Bentler 1999). The SRMR assesses the average magnitude of the discrepancies between observed and expected correlations as an absolute measure of (model) fit criterion. The SRMR of the model was 0.022 – below the recommended threshold of less than 0.080 at the 0.05 alpha level (Dijkstra and Henseler 2015; Hu and Bentler 1999), with $d_{ULS} = 0.176$ and $d_G = 0.040$. The results demonstrate, with a probability of 5%, that the measurement structure of the composite construct is correct. As such, the study proceeds to evaluate the specific properties of the composite construct.

Construct Validity

Next, construct validity was established for each construct using the average variance extracted (AVE). All the constructs demonstrated satisfactory convergent and discriminant validities, with the AVE for all seven constructs measuring above 0.5 (Cenfetelli and Bassellier 2009; Fornell and Larcker 1981). The AVE of each construct was greater than the variance shared between the construct and the other constructs in the model, thus indicating strong discriminant validity. Table 3 presents the results of the AVE analysis.

	1	2	3	4	5	6	7
Resource Readiness (1)	0.862						
Cultural Readiness (2)	0.244	0.901					
Strategy Readiness (3)	0.512	0.212	0.932				
Technology Readiness (4)	0.234	0.341	0.214	0.851			
Change Valance (5)	0.452	0.301	0.126	0.134	0.864		
Cognitive Readiness (6)	0.103	0.211	0.109	0.1	0.229	0.869	
Partnership Readiness (7)	0.542	0.192	0.411	0.135	0.341	0.411	0.912

Table 3: Construct correlation matrix

Testing the measurement model

Following the guidelines of researchers (e.g., Cenfetelli and Bassellier 2009; Diamantopoulos and Siguaw 2006; Diamantopoulos and Winklhofer 2001; Dijkstra and Henseler 2015; Henseler 2017), the items were first tested for multicollinearity among the measures using variance inflation factors (VIFs). The VIF from a regression of all the subconstructs ranged between 1.1 and 2.2, indicating that multicollinearity is not a problem in the study sample (Diamantopoulos and Siguaw 2006).

Figure 3 depicts the results of the measurement model test, with values significant at the 0.005 alpha level (Henseler et al. 2016). Supporting the study objective of deriving a construct, the results indicated that all the seven subconstructs demonstrated strong and significant predictors of organizational readiness for digital innovation. Overall, the model subconstructs explained 76% of the variance of organizational readiness for digital innovation construct (the adjusted R^2 of 0.764). This percentage of explanation exceeds the explanation of variances reported in comparable similar papers in the literature (e.g., Snyder-Halpern 2001; Yen et al. 2012) and is adequate considering model parsimony. Figure 3 shows that the study establishes the convergent and discriminant validity of the model subconstructs. The convergent validity of the constructs conformed to the heuristics, with all the t-values of the outer model weights exceeding the one-sided[8] cutoff of 1.645 levels[9] significant at the 0.05 (*) alpha protection level (Benitez et al. 2017; Henseler 2017; Henseler et al. 2016). By using the weights of the subconstructs of organizational readiness for digital innovation composite construct in Figure 3, the following observations are made.

The relative contribution of each subconstruct shows that the resource readiness, cultural readiness, and IT readiness make the largest respective contributions. Strategic readiness makes the lowest contribution. However, as mentioned, despite the low weight of strategic readiness subconstruct, it was retained in the interest of further assessment in future studies. This was acceptable because strategic readiness did not display excessive collinearity.

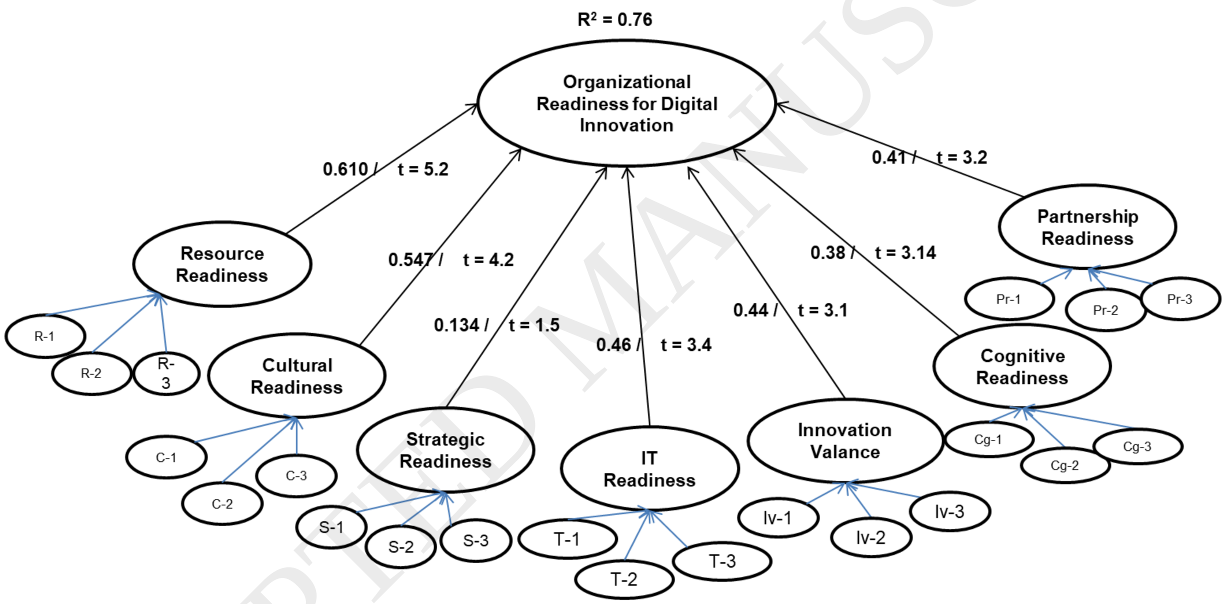

Figure 3: Results of the analysis explaining 76% of the variance

Additivity

Additivity was evidenced indirectly by the measurement model analysis. As a further test of additivity, next we averaged the items associated with each subconstruct to yield seven independent variables and regressed against the average of measures used for organizational readiness for digital innovation. In the case of each variable, the significant weights (and loadings)

[8] The one-sided test was appropriate because we hypothesized only a positive contribution of the formative components of expertise. The two-sided cutoff of 1.96 was used otherwise.
[9] The t-values of the loadings are equivalent to those in least-squares regressions. Each measurement item is explained by the linear regression of its latent construct and its measurement error (Diamantopoulos and Winklhofer 2001).

suggest that each indicator is important to the composite construct of organizational readiness for digital innovation. The results demonstrate that each independent variable makes a significant incremental contribution to R^2, thus suggesting that all seven subconstructs are useful in deriving the single overarching measure of organizational readiness for digital innovation.

The Acid Test – The Nomological Network

The acid test of a newly developed construct is the nomological network test, where the construct is implanted in its nomological network (Agarwal and Lucas Jr 2005). The assessment of the nomological network test, as prescribed by Cronbach and Meehl (1955), is an essential aspect of testing the validity of the construct[10].

Theoretically (and tautologically), the readiness theory argues that "implementation effectiveness" is the immediate and most salient dependent variable. Appropriately, "innovation implementation effectiveness" is considered as the immediate dependent variable of organizational readiness for digital innovation. In a simple hypothesis, one might conceive this as "higher organizational readiness leads to effective implementation of innovations" (Garvin 2012; Hall and Vredenburg 2012). However, this is not a foregone conclusion, where *any* level of readiness leads to an effective implementation of innovations. For instance, all organizations will hold some degree of readiness in one or several of the factors identified in organizational readiness for digital innovation model. However, only the firms with high readiness will be able to execute their innovations effectively (Snyder-Halpern 2001). To measure innovation implementation effectiveness, three reflective measures were created (see Appendix D) that provide an overarching measurement of the construct. The objective therein is to assess the impact of the newly developed readiness construct on the implementation effectiveness and not to develop a composite construct for the dependent variable. The three reflective measures of innovation (see Appendix D) loaded into a single factor with factor loadings of 0.7652, 0.6721, and 0.7451. The structural model analysis presented in Figure 4 shows the relationship between organizational readiness for digital innovation as the independent variable and innovation implementation effectiveness as the dependent variable. As Figure 4 depicts, the path coefficient was 0.651 and the R^2 was 0.41. The

[10] Cronbach and Meehl (1955) outline five steps in determining construct validity by the nomological network test: (i) at least have two constructs, (ii) theoretically or tautologically related, (iii) correspondence rule, (iv) empirical measurement of both constructs, and (v) empirical linkage through hypothesis development.

results were adequate to establish the measurement adequacy of the independent variable. Moreover, the model fit indicators were established for Figure 4 using SRMR, d_{ULS}, and d_G. The SRMR of the model was 0.021, d_{ULS} = 0.144, and d_G = 0.036, demonstrating a good model fit (Dijkstra and Henseler 2015; Hu and Bentler 1999). The results of the nomological network testing (Figure 4) evidenced not only the existence of a strong, positive relationship between organizational readiness for digital innovation and innovation implementation effectiveness as hypothesized but also the validity of both constructs; put simply, if either construct is not valid, it is unlikely to demonstrate a relationship (Diamantopoulos and Winklhofer 2001; Edwards and Bagozzi 2000). This further evidence of construct validity is sometimes referred to as "identification through structural relations" (see for e.g. Jarvis et al. (2003, p. 214: Figure 5, Panel 4).

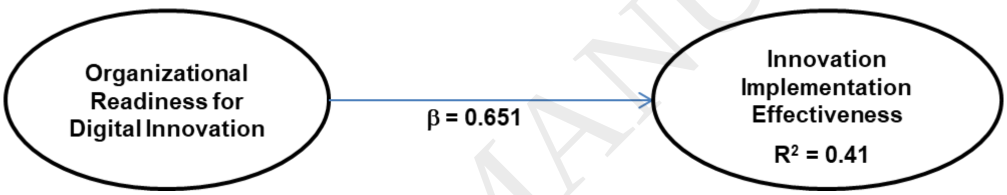

Figure 4: The nomological network of organizational readiness for digital innovation

Furthermore, a post hoc analysis was conducted to observe the direct effect of organizational readiness for digital innovation on the innovation implementation effectiveness. It also revealed strong and significant path coefficients (β at $p < 0.05$ confidence level *) for all organizational readiness for digital innovation factors ($\beta_{\text{Resource readiness}}$ = 0.32, $\beta_{\text{Cognitive readiness}}$ = 0.38, $\beta_{\text{IT readiness}}$ = 0.35, $\beta_{\text{Partnership readiness}}$ = 0.14, $\beta_{\text{Innovation valance}}$ = 0.31, $\beta_{\text{Cultural readiness}}$ = 0.26, and $\beta_{\text{Strategy readiness}}$ = 0.19).

Discussion of Results

The series of tests completed above generated a wealth of observations about organizational readiness for digital innovation construct.

The organizational readiness model for digital innovation

The formative organizational readiness for digital innovation construct is the main contribution of this study. Conceived using the readiness theory, the study derived seven subconstructs and 21 measures that purportedly measure organizational readiness for digital innovation. The measures were carefully derived from an inductive approach, and then the items were instantiated by an extensive literature review following the guidelines of Burton-Jones and Straub (2006). The proposed composite formative model was then validated using survey data. The seven subconstructs of organizational readiness for digital innovation made substantial and significant contributions, demonstrating research clarity and practitioner value.

Although this cross-sectional approach is often criticized for temporality, a snapshot of organizational readiness for digital innovation was precisely what was sought. Thus, it is suggested that the validated subconstructs and measures of organizational readiness for digital innovation can be used in combination as constructs of a measurement model for evaluating overall readiness. Alternatively, these same subconstructs and their related, validated measures may be used in a nomological network to test causality; in so doing, however, close attention must be paid to the timing of the measurement and the consequent direction of the paths. It is further noted that the validation of these constructs, either within a nomological network or a predictive chain or within a measurement model, lends credence to the constructs for either purpose[11].

To answer the provocative question "are these sub-constructs and related measures specific *only* to organizational readiness for digital innovation?", further testing is required. The specificity of the *measures* and the 76% variance explained provide evidence of a model that has both parsimony and completeness. The nomological network test between organizational readiness for digital innovation and innovation implementation effectiveness provided further confidence that the model derived herein can be applied to gauge organizational readiness for digital innovation.

This paper has stringently treated the model as composite formative. The authors have paid an extensive attention to the completeness, mutual exclusivity, and necessity of the subconstructs of the model. Overall, the model statistics (e.g., variance explained, CVR, VIF, and AVE) evidenced a strong model, with adequate attention to model parsimony (e.g., removing measures with less than 2% citations).

[11] Having said this, it is further encouraged that researchers heed the caution of Burton-Jones and Straub (2006) that operationalization must be undertaken in full light of the specific theory and hypotheses being tested.

Implications for Research

This research makes a specific contribution to the fields of research in digital innovation (Abrell et al. 2016; Huang et al. 2017; Svahn et al. 2017) and the business value of IT (Benitez et al. 2018a; Benitez et al. 2018b; Chen et al. 2015; Chen et al. 2017). Both fields had been making substantial contributions to research for the past several decades (Bohnsack et al. 2014; Melville et al. 2004; Mukhopadhyay et al. 1995; Sabherwal and Jeyaraj 2016). However, the evolution of technologies means that the study endeavors to understand the role of IT in business and innovation must be continuous. The availability, accessibility, scalability, and ease-of-use and ease-of-deployment of digital technologies have increased the temptation (and the necessity) for all organizations to innovate using such technologies. This readiness construct will allow organizations to guide their ambitions on the basis of the capabilities available to them as well as its environmental factors. Organizational readiness for digital innovation construct derived from this study and the approach followed in its development address several areas of uncertainty in past IS research.

First, the derivation of organizational readiness for digital innovation construct allows researchers to understand both dependent and independent variables of its nomological network. For example, the readiness construct can be the independent variables in the business value of IT studies (Hitt and Brynjolfsson 1996; Melville et al. 2004), where the change in the value of IT can be explained through the level of readiness. Moreover, the developed model and its subconstructs can serve within any of the existing theories that have been employed to understand the phenomenon better (Barney 1991; Im and Rai 2014). For example, by using the current model, researchers can explain the role that organizational readiness plays in better explaining ambidexterity (Benitez et al. 2018a; Im and Rai 2014) .

Second, this study makes a substantial contribution to the studies on antecedents of innovation. Over the past several decades, there has been substantial work on the antecedents of innovation (Saemundsson and Candi 2013; Wan et al. 2015). For example, Somech (2006) observes the important role of leadership in innovation, while Roy and Sarkar (2016) provide evidence of the importance of knowledge management for innovation. Considering the plethora of studies highlighting such antecedents of innovation and the importance of innovation, this study provides a consolidated approach that considers extant theory and literature to derive a model that gauges organizational readiness for digital innovation.

Third, the study represents the first test of the sufficiency and necessity (or not) of an organizational readiness construct for digital innovation with seven validated subconstructs. Though the broad themes were derived using the readiness theory, the development of the seven subconstructs and their measures is a valuable contribution to the referent theory. To the extent that the readiness construct is robust across contexts and time, the construct may serve as a validated independent variable in ongoing research on the drivers of innovation. As an independent variable, organizational readiness for digital innovation model may aid in understanding the relationship between IT and organizational innovation (or organizational performance as an ultimate variable). With further research, organizational readiness for digital innovation construct may ultimately yield valuable cross-organizational comparisons of digital innovation readiness among application areas, system sourcing scenarios, sectors, geography, cultures, organization size, and other demographic groupings.

Fourth, some of the subconstructs in organizational readiness construct had been discussed in the past literature. The holistic nature of the construct allows researchers to understand how the current body of knowledge fits into organizational readiness for digital innovation. For example, studies looking at the role of enterprise systems and technology platforms in digital innovation (e.g., Sedera et al. 2016) are recognized in the model for its corresponding role. Similarly, recent publications acknowledged the role of resource availability (Pan et al. 2015), configuration of resources (Cui and Pan 2015), and importance of partnerships (Benitez et al. 2018b). By using the innovation readiness construct, researchers can observe the relative importance of such factors against a complete set of readiness constructs, thus allowing comparisons with a holistic view of innovation readiness.

Implications for Practice

First, organizational readiness for digital innovation construct may be of interest to firms seeking to evaluate how ready they are to innovate with contemporary IS using an easy-to-understand, simple, and perceptual survey instrument. The construct and the related survey instrument take only a short time to execute and analyze organizational readiness for digital innovation. They also allow organizations to avoid making “false starts,” which have been blamed for the notoriously high rate of innovation failures (Nylén and Holmström 2015). Second, the readiness construct can be used to assess the level of readiness from multiple stakeholder perspectives. The subconstructs employed herein are flexible enough to gather views from all levels within the organization, including the executives, managers, and operational staff. Innovation literature suggests that gathering such consolidated views is essential for the success of innovations (Laforet 2013). At the same time, the study witnessed significant differences in views on organizational readiness for digital innovation between the CIOs and the LOB managers. Further understanding of such disagreements will lead to possible identification of reasons why most innovation attempts are unsuccessful. Third, practitioners can employ organizational readiness for digital innovation construct to assess the mix of tangible (e.g., resources) and less tangible indicators (e.g., culture). Practitioner literature highlights the importance and the necessity of considering all factors before engaging in innovation (Swanson 2012). Fourth, organizational readiness for digital innovation construct can be used to establish benchmarks for comparison across firms, departments, or other demographic groupings. Periodic benchmarks demonstrate the progress that an organization makes in relation to a particular subconstruct, allowing them to identify facets of improvements or facilitate organizational-wide knowledge on the capabilities. Fifth, organizational readiness for digital innovation can be a tool to allocate and manage investments into digital innovation readiness factors. Having understood, benchmarked, and identified possible areas of strength and weakness in relation to organizational readiness for digital innovation subconstructs, the organizations can now allocate resources on the basis of evidence. Finally, the construct will develop an evidence-based practice to focus on resources and capabilities and pay attention to those aspects that are lacking in an organization. Such an approach will mitigate the risks involved in digital technologies and innovations in general. Analyses of the data samples based on various demographics or other distinctions can facilitate potentially useful comparisons for practitioners. As a rule, highly consistent scores indicate some level of consensus about the constructs of organizational readiness for digital innovation (e.g., across the full sample, within stakeholder groups, or within organizational entities). However, inconsistent scoring may point to areas of difference within these groupings, thus warranting attention.

Limitations and Future Research

There are several limitations of organizational readiness for digital innovation construct that require attention in future studies. First, the model was developed and validated with a sample of 189 firms and may be perceived as a small sample considering the global scale of digital innovation. While the construct seems complete for now, future studies are required and can employ the readiness construct to draw novel research pathways to better understand the role of IT in a cumulative fashion. The construct would gain further credibility by testing it longitudinally to understand its measurement capacity of organizational readiness for digital innovation over time.

Further, researchers argue (e.g., Parasuraman 2000) that research on organization-level (innovation) readiness can provide only a partial elucidation of the phenomenon. It is acknowledged that the readiness construct may be sensitive to particular types of innovations (Yen et al. 2012) and its adoption context (Kwahk and Lee 2008; Molla and Licker 2005). These raise questions about whether the a priori model was in fact complete and representative of contemporary IS in general and whether the final subconstructs and list of measures are, indeed, generalizable. Thus, although the initial findings are encouraging, further research is necessary to extend generalizability. Specifically, generalizability could be strengthened by retesting the model in diverse settings of various systems, contexts, and timelines.

Appendix A: A collection of examples of digital innovation

Case Name	Scenario	Details
Starwood	Starwood's SPG Keyless lets guests access their room with a smartphone	The Starwood hotel chain collaborated with ASSA ABLOY Hospitality to provide keyless access to their members. This B2B offering is enabled through the orchestration of RFID, smartphone, and the hotel’s management system (Ross 2015).
L'Oreal	L'Oreal Makeup Genius App uses Augmented Reality to try on makeup	This B2C initiative uses mobile, enterprise system, augmented reality, and eCommerce platform to offer this product to the customers (Trefis Team 2016).
Nestle	Nestle has created a smartphone app-connected baby formula machine	Nestle developed a baby formula machine that connects to the Nestle smartphone app. This app connects to dieticians and gets support and insights about the growth of the child. The product is a combination of multiple technologies such as wireless technology, mobile, enterprise system, internet of things, eCommerce, and data analytics (Babynes 2015).
Paulig	Paulig’s connected coffee mug	The connected mug is a B2C offering that combines wireless technology, social media, mobile, and internet of things. The mug is powered entirely by the thermal energy from hot coffee (Paulig Group 2015).

Ralph Lauren	Ralph Lauren has created a shirt with fitness monitoring capability	The shirt includes wireless technology, mobile, and sensors that track the fitness of an athlete (Smith 2016).
Amazon	Amazon Dash Buttons can automatically (re)order products when pressed	This product is built using wireless technology, mobile, enterprise system, internet of things, and eCommerce technologies to make ordering easy (Gibbs 2016).
Aviva	Aviva Drive App helps safer drivers to win an insurance discount	This mobile app uses enterprise system, mobile, social media, sensors, and data analytics to provide incentives to the customers of Aviva (AVIVA 2016).
Barclays	Barclays makes payment a digital wearable option for customers	The Barclays digital wearable uses mobile and internet of things to provide contactless payments (Curry 2015).
City of Montreal	City of Montreal Info-Neige: real-time tracking of snow plows to help citizens	This B2C service is developed using mobile, enterprise system, and sensors to provide real-time information regarding snow conditions to their citizens (A Ville de Montréal 2015).
Disney	Disney's wearable magic bands creates magical experience	This magic band is designed to help people in reducing the amount of time they spend in strategizing, and it provides a great customer care. This initiative uses wireless technology, enterprise system, sensors, internet of things, and eCommerce to provide a better service (Panzarino 2013).

Appendix B: Readiness to innovate

Organizational readiness is a much discussed topic in various disciplines such as management (Jones et al. 2005; Weeks et al. 2004), healthcare (Fuller et al. 2007; Saldana et al. 2007), and IS (Robey et al. 2008; Zhu et al. 2003). In a broadest sense, readiness describes the state of being fully ready to engage in a specific activity. The definition highlights the importance of timing, state, and the specificity of the activity that is getting ready for. In other words, readiness is a *state* that is attained *prior* to the commencement of a *specific* activity in relation to psychological, behavioral, and structural preparedness of the organizations (Helfrich et al. 2011). For example, in health discipline, scholars have applied organizational readiness context to measure the readiness of organizations and therapists to adopt evidence-based practices (Saldana et al. 2007). There are also studies that investigated readiness in implementing new technologies into a treatment program (Lehman et al. 2002) and also in management science, and readiness was also discussed in relation to the introduction of a new management program (Eby et al. 2000). In addition, organizational readiness has been discussed in relation to knowledge management initiatives (Holt et al. 2007), innovation efforts (Snyder-Halpern 2001), and implementation of a technology (Abdinnour-Helm et al. 2003).

Readiness is measured at the individual, team, department, or organizational level, thus making it possible to draw observations from any of these levels. Individual readiness is a much-discussed topic in the management and psychology discipline primarily focused on quitting harmful habits such as smoking and drug abuse (Block and Keller 1998). In IS, readiness is discussed under themes such as systems implementation (Abdinnour-Helm et al. 2003; Snyder-Halpern 2001), knowledge management (Holt et al. 2007), e-readiness (Molla and Licker 2005), and green readiness (Molla et al. 2009). In these studies, readiness is referred to as a precursor condition (or set of conditions) for the implementation of initiatives such as a change, IS, or innovation (Guha et al. 1997) or readiness as a capability of an organization that requires continuous improvement (Clark et al. 1997). In this study, readiness is considered as a capability. To reassure the validity of the construct in its nomological net, its (i.e., the construct's) impact on the innovation implementation effectiveness was analyzed.

Moreover, readiness is best conceptualized as a degree of readiness rather than as a dichotomous variable. In other words, one should not see readiness state as "ready" or "not ready."

Rather, there can be a degree of readiness. Moreover, the measurement of readiness of an organization is crucial as it (i) provides a preassessment of the organization's tangible and intangible capabilities, (ii) indicates where the capability building is required, and (iii) reduces the risk of failure (Bharadwaj 2000; Molla et al. 2009; Yen et al. 2012). A measurement of readiness construct is also important as "the development and distribution of capabilities are not uniform across firms and are highly organization-specific (Molla et al. 2009, p. 71)." As such, an assessment of readiness can provide continuous guidelines to allocate capabilities and resources for a given objective (Molla et al. 2009).

This study investigates the organizational readiness construct with reference to digital innovation. Digital innovation is defined as the creation of new waves of organizational, technical, and cognitive challenges in firms using digital technologies (Henfridsson et al. 2014; Yoo et al. 2010). As such, organizational readiness for digital innovation refers to the ability of an organization to initiate innovation with digital technologies. Consistent with Nylén (2015), this study considers both product and process innovations that are initiated with digital technologies.

An analysis of top eight IS journals from their inceptions revealed that most of the work has been carried out on organizational readiness for *IT adoption*. For example, Iacovou et al. (1995) discuss organizational readiness for electronic data interchange adoption and introduce factors that influence organizational readiness for adoption. Iacovou et al. (1995) refer organizational readiness as the level of (i) financial and (ii) technological resources availability of the organization. As such, Iacovou et al. (1995) measures include financial readiness and IT readiness of an organization. In general, there is consensus in IS discipline that the following variables have been employed in readiness studies: (i) financial resources (Chwelos et al. 2001), (ii) IT sophistication (Chwelos et al. 2001; Robey et al. 2008), (iii) management support (Jansen et al. 2006), (iv) trading partner readiness (Robey et al. 2008), (v) elapsed time since adoption (Robey et al. 2008), (vi) organizational culture (Damanpour 1991; Jansen et al. 2006), (vii) communication of goals (Bharadwaj et al. 2013; Kivimäki et al. 2000), (viii) individual attitude (Damanpour and Schneider 2006; Evanschitzky et al. 2012), and (ix) commitment (Damanpour 1991).

Appendix C: Details of Study-1 respondents and case details

Case	Industry Sector	Origin	Respondents	Duration
C1	Private Sector/Logistics	Europe	CIO	1 h 25 min
			Director of Logistics	1 h
C2	Private Sector/Dairy	Europe	IT Manager	55 min
			Brand Manager	1 h
C3	Private Sector/Energy	Europe	SAP Technical Lead	2 h
			IT Manager	1 h 5 min
C4	Private Sector/Manufacturing	Australia	Chief Technology Officer	2 h
			SAP Technical Consultant	2 h
C5	Private Sector/Telecommunication	Asia	Group Chief Technology Officer	1 h 5 min
			BI Lead	1 h 10 min
C6	Public Sector/Transport	Australia	CIO	1 h 30 min
			BI Department Head	2 h
C7	Private Sector/Insurance	Asia	CIO and General Manager	1 h 5 min
			Sales and Claims Processing Manager	2 h
C8	Private Sector/Dairy	Europe	Supply Plan Manager	40 min
			CIO	45 min
C9	Not-for-Profit/Health	Australia	CIO	1 h
			Manager	2 h 5 min

Appendix D: Digital innovation readiness survey instrument

This survey measures *the readiness of your organization to innovate with digital technologies*. *The term IT portfolio in the survey* refers to technologies like cloud computing, wearables, mobile technologies, social media, and business analytics. In this survey, the term innovation refers to "the production or adoption, assimilation, and exploitation of a value-added novelty in economic and social spheres; renewal and enlargement of products, services, and markets; development of new methods of production; and establishment of new management systems."

Resource readiness

(R-1) My organization is flexible in allocating adequate financial resources necessary to innovate with the IT portfolio.

(R-2) My organization is flexible in allocating adequate human resources necessary to innovate with the IT portfolio.

(R-3) My organization is flexible in allocating adequate IT infrastructure resources necessary to innovate with the IT portfolio.

Cultural readiness

(C-1) My organization has a well-established way of sharing ideas and thoughts to engage with the IT portfolio for innovations.

(C-2) My organization has a decentralized decision-making process that facilitates the engagement of all business areas to use the IT portfolio for innovations.

(C-3) My organization takes reasonable risk assessment of engaging IT to facilitate innovations.

Strategic readiness

(S-1) Our organizational strategic goals are clear to me when engaging the IT portfolio to facilitate innovations.

(S-2) Our organizational strategic goals are relevant to me when using the IT portfolio to facilitate innovations.

(S-3) I am well-aware of our organizational strategic goals communicated to me for using the IT portfolio to facilitate innovations.

IT readiness

(T-1) Enterprise system/s in my organization is/are stable, up-to-date, and reliable.

(T-2) I have access to a range of new technologies like cloud, mobile, social media, and big data analytics available to facilitate innovations.

(T-3) Our IT infrastructure is stable, up-to-date, and reliable to facilitate innovations.

Innovation valance

(Iv-1) Our staff members have the right attitudes that facilitate innovations.

(Iv-2) Our staff members are motivated to facilitate innovations.

(Iv-3) Our staff members are empowered to make decisions that facilitate innovations.

Cognitive readiness

(Cg-1) Our staff members have the appropriate knowledge (i.e., technical, business process, and organizational) to facilitate innovations.

(Cg-2) Our staff members have the appropriate skills to facilitate innovations.

(Cg-3) Our staff members have the appropriate adaptability to facilitate innovation.

Partnership readiness

(Pr-1) My organization has a good relationship with the software vendors to facilitate innovations.

(Pr-2) My organization has a good relationship with the management consultants to facilitate innovations.

(Pr-3) My organization has a good relationship with our suppliers and vendors to facilitate innovations.

Global measures of organizational readiness for digital innovation

(Global-1) Our IT portfolio is well-equipped to support any innovations in the organization.

(Global-2) Our organization is well-equipped to support any innovations.

Innovation implementation effectiveness

(InnovationImp-1) We are good at implementing new ideas in the organization.

(InnovationImp-2) We have introduced enough new products and services to compete with our competition.

(InnovationImp-3) Most of our new ideas are now implemented.

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